
काँच के धारक की पोलारिस्कोपिक जांच
की पद्धतियाँ
(पहला पुनरीक्षण)

Methods of Polariscopic
Examination of Glassware
(First Revision)

ICS 81.040.30

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Glass, Glassware & Laboratoryware Sectional Committee had been approved by the Chemical Division Council.

The apparent temper as determined by the methods given in this standard depends primarily on the magnitude and distribution of strain in glass, the thickness of glass (optical path), and to a minor extent on the composition of glass. According to this standard annealing is to be reported (*see 5*) as the temper number, number of discs or degree of rotation of the analyzer in accordance with the tabulations given in **3.3.1.1** and **4.2.1.1** but the interpretation of this apparent temper in terms of real temper requires consideration of the above factors in addition to the practical experience with the particular ware being evaluated.

This Indian Standard was originally published in 1978. First revision of this standard was taken in view of the latest technological advancements that had taken place in the industry and accordingly the values for analyzer rotation degrees in Table 2 is modified and several editorial changes such as inclusion of reference clause, hindi title, ICS No. etc, was also incorporated.

In the formulation of this standard, assistance has been derived from the following publications:

ASTM C148-17 'Standard Test Methods for Polariscopic Examination of Glass Containers'.

The composition of the committee responsible for the formulation of this standard is listed in Annex A.

In reporting the results of a test or analysis made in accordance with this standard, is to be round off, it shall be done on accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'.

*Indian Standard***METHODS OF POLARISCOPIC EXAMINATION OF GLASSWARE***(First Revision)***1 SCOPE**

1.1 This standard prescribes methods of polariscopic examination of glassware for determining the relative annealing strain in them.

1.2 Two methods are prescribed. Method A is based on comparison with standard strain discs using a polariscope and method B on measurement of strain using a polarimeter.

2 SAMPLING

Representative samples of glassware shall be drawn as specified in respective material specification Indian Standard.

3 METHOD A — COMPARISON WITH STANDARD STRAIN DISCS USING A POLARISCOPE**3.1 General**

For wares having strain greater than temper No. 6, evaluation may be done using polarimeter (*see* method B in 4).

3.2 Apparatus**3.2.1 Polariscope**

Conforming to the following requirements:

- a) The high brightness of the field shall be at least 308 cd/m² at the point where glassware is held for examination and at least 171 cd/m² at the edge of the field as observed with the polarizing element and protective element in operating position;
- b) The degree of polarization of the field at all points shall not be less than 99.0 percent;
- c) The field shall be of sufficient size to permit the examination of the whole ware 25 cm in height at one viewing; and
- d) A sensitive tint plate standardized to give an optical retardation of 565 nm shall be used.

3.2.2 Standard Strain Discs

Such discs shall be circular plates of glass between 7.5 cm and 10 cm in diameter and having nominal residual strain (about 6 mm from the edge) corresponding to not less than 21.8 nm and not more than 23.8 nm of optical retardation.

NOTE — In standardizing such discs for measurement or calibration, error shall not exceed 0.7 nm.

3.3 Procedure**3.3.1 Examination of Base of Cylindrical Glassware**

Rotate the analyzer so as to have its plane of polarization perpendicular to that of the polarizer. The field should look black. Introduce the container in the field of vision and view its base through the neck. Compare the maximum broad colour pattern in the base of the container with the maximum colour in various numbers of the standard strain discs stacked one on top of the other to determine whether the maximum amount of colour in the base is less than that in one disc, greater than one but less than two; greater than two but less than three; etc.

NOTE — It is seldom possible to obtain an exact match of the colour of container with the reference standards.

3.3.1.1 Record the temper number of the container in accordance with the following rule.

Rule — When the colour of a container is greater than the equivalent number (N) of discs but less than N + 1 discs, the grade is N + 1; that is, corresponding numerically to the larger number of discs, as specified in Table 1.

Table 1 Temper No. and Equivalent Number of Discs

(Clause 3.3.1.1)

Sl No.	Temper No.	Equivalent Number of Discs
(1)	(2)	(3)
i)	1	Less than 1 disc
ii)	2	Less than 2 but greater than 1 discs
iii)	3	Less than 3 but greater than 2 discs
iv)	4	Less than 4 but greater than 3 discs
v)	5	Less than 5 but greater than 4 discs
vi)	6	Less than 6 but greater than 5 discs

NOTE — Each disc has an optical retardation of about 22.8 nm at the calibration point about 6 mm from the edge. In practice each disc has an effective maximum optical retardation of about 23.7 nm near the edge

3.3.2 Examination of Square, Oval and Irregular Shapes

Make the polariscopic examination at the curve or corner that shows the most colour, and record the temper number in accordance with the rule given in 3.3.1.1.

3.3.3 Examination of Sidewalls

Match the maximum colour of any part of the sidewall with the maximum colour in any part of the discs, and record the temper number in accordance with the rule given in 3.3.1.1.

3.3.4 Examination of Coloured Ware

Using the polariscope with the tint plate [see 3.2.1 (d)] removed, look at the base of the container through the neck and select for reference the darkest area (usually the centre of the base), then, with the tint plate in place hold a standard disc under the base of the container so that the portion of the edge of the disc, which shows maximum colour, is underneath the reference areas. Compare the colour of the reference area as modified by the presence of the disc with the maximum colour in the edge of the base. Rotate the container to find the point giving maximum colour. If this colour is greater than the modified colour in the reference area, use two or more discs and grade the annealing in accordance with the rule given in 3.3.1.1.

4 METHOD B — DETERMINATION OF APPARENT TEMPER WITH A POLARIMETER

4.1 Apparatus

4.1.1 Polarimeter

Conforming to the following requirements:

- The high brightness of the field shall be at least 308 cd/m² at the point where the glassware is held for examination and at least 171 cd/m² at the edge of the field, as observed with the polarizing element and protective element in operating position;
- The degree of polarization of the field at all points shall not be less than 99.0 percent;
- The field shall be of sufficient size to permit the examination of the whole ware 25 cm in height at one viewing;
- The source of light shall consist of 75 W or 100 W incandescent lamp bulbs so arranged as to satisfy the brightness requirements stated in (a) above;
- A quarter-wave plate with an optical retardation of 141 nm shall be inserted between the polarizer and the analyzer with its slow axis at 90° to the plane of polarization of the polarizer; and

- The analyzer shall be so mounted that it can be rotated with respect to the polarizer and quarter-plate, and the angle of rotation determined.

4.2 Procedure

4.2.1 Examination of Base of Cylindrical Glassware

Rotate the analyzer so as to have its plane of polarization perpendicular to that of the polarizer. This is the zero position and the field should be black. Introduce the container in the field of vision and view the bottom through the neck. A dark cross will appear in the field between the areas which would show colour in a tint plate polariscope. In containers with low temper number, this cross will be hazy and indistinct. Rotating the analyzer causes the dark cross to separate into two areas which proceed outward in opposite directions towards the heel of the container. As these dark areas move outward, they develop a blue-grey colour on the concave side and a brown colour on the convex side. In measuring the birefringence of a selected point in a container, rotate the analyzer until the blue-grey colour is just displaced by the brown colour at the selected point. Rotate the container itself about its own axis to determine if the region of maximum birefringence has been selected; if not, rotate the analyzer further to displace the blue-grey colour with the brown in the region of maximum birefringence.

4.2.1.1 Convert the angle of rotation of the analyzer to temper number as given in Table 2.

Table 2 Temper No. and Analyzer Rotation, Degrees
(Clause 4.2.1.1)

Sl No.	Temper No.	Analyzer Rotation, Degrees
(1)	(2)	(3)
i)	1	0.0 - 7.4
ii)	2	7.5 - 14.9
iii)	3	15.0 - 22.4
iv)	4	22.5 - 29.9
v)	5	30.0 - 37.4
vi)	6	37.5 - 44.9
vii)	7	45.0 - 52.4
viii)	8	52.5 - 59.9
ix)	9	60.0 - 67.4
x)	10	67.5 - 74.9

NOTE — One degree of rotation of the analyzer is equivalent to about 3.14 nm optical retardation when using a white light source as specified in 4.1.1(d) (effective wave-length approximately 565 nm). Thus, the equivalent value is taken to be 7.5° rotation for disc as used in method A.

4.2.2 Examination of Square, Oval and Irregular Shapes

Make the examination at the curve or corner that reveals the most birefringence when examined in accordance with the procedure given in **4.2.1**.

4.2.3 Examination of Sidewalls

Introduce the container in the polarimeter with its axis at 45° to the plane of polarization. No dark crosses will be apparent. Rather, broad areas of varying lightness and darkness will be visible in the container. In this case, rotate the analyzer until the dark shadows converge on and displace the last remaining light areas in the sidewalls. It may be necessary to rotate the container about its own axis to determine the areas of most birefringence. Convert the degree of rotation of the analyzer to temper number in accordance with **4.2.1.1**.

4.2.4 Examination of Coloured Ware

Use the same procedure as in **4.2.1**. It is more

difficult to distinguish the end point in coloured ware, particularly in darker colours, because of the absence of the characteristic blue and brown and also because of the lower level of light intensity. In dark samples the most accurate indication of the end point is obtained by averaging the rotation necessary to displace the light area with dark and the total rotation necessary to just make the light area reappear.

5 TEST REPORT

It shall clearly indicate the following information:

- a) The temper number;
- b) Number of standard strain disc, or degrees of rotation of the analyzer, as the case may be, for each container;
- c) Reference to this standard with year; and
- d) Date of the test report issuance.

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

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